Computer Control Programmers and Operators

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Significant Points

- Manufacturing industries employ almost all of these workers.
- Workers learn in apprenticeship programs, informally on the job, and in secondary, vocational, or post-secondary schools; many entrants have previously worked as machinists or machine setters, operators, and tenders.
- Despite the projected decline in employment, job opportunities should be good, as employers are expected to continue to have difficulty finding qualified workers.

Nature of the Work

Computer control programmers and operators use computer numerically controlled (CNC) machines to cut and shape precision products, such as automobile parts, machine parts, and compressors. CNC machines include machining tools such as lathes, multiaxis spindles, milling machines, laser cutting, water jet cutting, and wire electrical discharge machines (EDM), but the functions formerly performed by human operators are performed by a computer-control module. CNC machines cut away material from a solid block of metal, plastic, or glass—known as a workpiece—to form a finished part. Computer control programmers and operators normally produce large quantities of one part, although they may produce small batches or one-of-a-kind items. They use their knowledge of the working properties of metals and their skill with CNC programming to design and carry out the operations needed to make machined products that meet precise specifications.

Before CNC programmers—also referred to as numerical tool and process control programmers—machine a part, they must carefully plan and prepare the operation. First, these workers review three-dimensional computer aided/automated design (CAD) blueprints of the part. Next, they calculate where to cut or bore into the workpiece, how fast to feed the metal into the machine, and how much metal to remove. They then select tools and materials for the job and plan the sequence of cutting and finishing operations.

Next, CNC programmers turn the planned machining operations into a set of instructions. These instructions are translated into a computer aided/automated manufacturing (CAM) program containing a set of commands for the machine to follow. These commands normally are a series of numbers (hence, numerical control) that describes where cuts should occur, what type of cut should be used, and the speed of the cut. CNC programmers and operators check new programs to ensure that the machinery will function properly and that the output will meet specifications. Because a problem with the program could damage costly machinery and cutting tools or simply waste valuable time and materials, computer simulations may be used to check the program instead of a trial run. If errors are found, the program must be changed and retested until the problem is resolved. In addition, growing connectivity between CAD/CAM software and CNC machine tools is raising productivity by automatically translating designs into instructions for the computer controller on the machine tool. These new CAM technologies enable programs to be easily modified for use on other jobs with similar specifications.

After the programming work is completed, CNC operators—also referred to as computer-controlled machine tool operators, metal and plastic—perform the necessary machining operations. The CNC operators transfer the commands from the server to the CNC control module using a computer network link or floppy disk. Many advanced control modules are conversational, meaning that they ask the operator a series of questions about the nature of the task. CNC operators position the metal stock on the CNC machine tool—spindle, lathe, milling machine, or other—set the controls, and let the computer make the cuts. Heavier objects may be loaded with the assistance of other workers, autoloaders, a crane, or a forklift. During the machining process, computer-control operators constantly check to see if any problems exist. Machine tools have unique characteristics, which can be problematic. During a machining operation, the operator modifies the cutting program to account for any problems encountered. Operators who make these adjustments need a basic knowledge of CNC programming. Unique, modified CNC programs are saved for every different machine that performs a task.

In order to boost productivity, manufacturers increasing prefer workers who can quickly adapt to new technology and perform a wide range of tasks. As a result, CNC operators often are required to perform many of the basic skills of a machinist and a CNC programmer. However, some manufacturers simply need CNC operators to be "button-pushers." They primarily start and stop machines, load cutting programs, and load and unload parts and tools.

Regardless of skill level, all CNC operators detect some problems by listening for specific sounds—for example, a dull cutting tool that needs changing or excessive vibration. Machine tools rotate at high speeds, which can create problems with harmonic vibrations in the workpiece. Vibrations cause the machine tools to make minor cutting errors, hurting the quality of the product. Operators listen for vibrations and then adjust the cutting speed to compensate. In older, slower machine tools, the cutting speed would be reduced to eliminate the vibrations, but the amount of time needed to finish the product would increase as a result. In newer, high-speed CNC machines, increasing the cutting speed normally eliminates the vibrations and reduces production time. CNC operators also ensure that the workpiece is being properly lubricated and cooled, because the machining of metal products generates a significant amount of heat.

Since CNC machines can operate with limited input from the operator, a single operator may monitor several machines simultaneously. Typically, an operator might monitor two machines cutting relatively simple parts cut from softer materials, while devoting most of his or her attention to a third machine cutting a much more difficult part cut from a hard metal, such as stainless steel. Operators are often expected to carefully schedule their work so that all of the machines are always operating.

Working Conditions

Most machine shops are clean, well lit, and ventilated. Most modern CNC machines are partially or totally enclosed, minimizing the exposure of workers to noise, debris, and the lubricants used to cool workpieces during machining. Nevertheless, working around machine tools presents certain dangers, and workers must follow safety precautions. Computer-controlled machine tool operators, metal and plastic, wear protective equipment, such as safety glasses to shield against bits of flying metal and earplugs to dampen machinery noise. They also must exercise caution when handling hazardous coolants and lubricants. The job requires stamina because operators stand

Computer control operators load programs into a machine.

most of the day and, at times, may need to lift moderately heavy workpieces.

Numerical tool and process control programmers work on desktop computers in offices that typically are near, but separate from, the shop floor. These work areas usually are clean, well lit, and free of machine noise. Numerical tool and process control programmers occasionally need to enter the shop floor to monitor CNC machining operations. On the shop floor, CNC programmers encounter the same hazards and exercise the same safety precautions as do CNC operators.

Most computer control programmers and operators work a 40-hour week. CNC operators increasingly work evening and weekend shifts as companies justify investments in more expensive machinery by extending hours of operation. Overtime is common during peak production periods.

Training, Other Qualifications, and Advancement

Computer control programmers and operators train in various ways—in apprenticeship programs, informally on the job, and in secondary, vocational, or postsecondary schools. In general, the more skills needed for the job, the more education and training that is needed to qualify. For example, a growing number of computer control programmers and the more skilled operators are receiving their formal training from community or technical colleges. For some specialized types of programming, such as that needed to produce complex parts for the aerospace or shipbuilding industries, employers may prefer individuals with a degree in engineering.

Less-skilled CNC operators (button-pushers) may need only a couple of weeks of on-the-job training.

Employers prefer to hire workers who have a basic knowledge of computers and electronics and experience with machine tools. In fact, many entrants to these occupations have previously worked as machinists or machine setters, operators, and tenders. Due to a shortage of applicants with the appropriate training, many employers are providing introductory courses in operating metalworking machines, safety, and blueprint reading. Persons interested in becoming computer control programmers or operators should be mechanically inclined and able to work independently and do highly accurate work.

High school or vocational school courses in mathematics (trigonometry and algebra), blueprint reading, computer programming, metalworking, and drafting are recommended. Apprenticeship programs consist of shop training and related classroom instruction. In shop training, apprentices learn filing, handtapping, and dowel fitting, as well as the operation of various machine tools. Classroom instruction includes math, physics, programming, blueprint reading, CAD software, safety, and shop practices. Skilled computer control programmers and operators need an understanding of the machining process, including the complex physics that occur at the cutting point. Thus, most training programs teach CNC operators and programmers to perform operations on manual machines prior to operating CNC machines.

To boost the skill level of all metalworkers and to create a more uniform standard of competency, a number of training facilities and colleges have recently begun implementing curriculums incorporating national skills standards developed by the National Institute of Metalworking Skills (NIMS). After completing such a curriculum and passing a performance requirement and written exam, trainees are granted a NIMS credential that provides formal recognition of competency in a metalworking field. Completion of a formal certification program provides expanded career opportunities.

Classroom training includes an introduction to computer numerical control, the basics of programming, and more complex topics, such as computer-aided manufacturing. Trainees start writing simple programs under the direction of an experienced programmer. Although machinery manufacturers are trying to standardize programming languages, there are numerous languages in use. Because of this, computer control programmers and operators should be able to learn new programming languages.

As new automation is introduced, computer control programmers and operators normally receive additional training to update their skills. This training usually is provided by a representative of the equipment manufacturer or a local technical school. Many employers offer tuition reimbursement for job-related courses.

Computer control programmers and operators can advance in several ways. Experienced CNC operators may become CNC programmers, and some are promoted to supervisory or administrative positions in their firms. A few open their own shops.

Employment

Computer control programmers and operators held about 143,000 jobs in 2004, mostly working in machine shops, plastics products manufacturing, machinery manufacturing, or transportation equipment manufacturing making mostly aerospace and automobile parts. Although computer control programmers and operators work in all parts of the country, jobs are most plentiful in the areas where manufacturing is concentrated.

Job Outlook

Computer control programmers and operators should have good job opportunities, despite the projected decline in employment. Due to the limited number of people entering training programs, employers are expected to continue to have difficulty finding workers with the necessary skills and knowledge.

Employment of both computer-controlled machine tool operators and numerical tool and process control programmers is expected to decline through 2014. While CNC machine tools will be increasingly used, advances in CNC machine tools and manufacturing technology

will further automate the production process, boosting CNC operator productivity and limiting employment. The demand for computer control programmers also will be negatively affected by the increasing use of software (CAD/CAM) that automatically translates part and product designs into CNC machine tool instructions.

Employment levels of computer control programmers and operators are influenced by economic cycles—as the demand for machined goods falls, programmers and operators involved in production may be laid off or forced to work fewer hours.

Earnings

Median hourly earnings of computer-controlled machine tool operators, metal and plastic, were $14.75 in May 2004. The middle 50 percent earned between $11.65 and $18.21. The lowest 10 percent earned less than $9.47, whereas the top 10 percent earned more than $21.67. Median hourly earnings in the manufacturing industries employing the largest numbers of computer-controlled machine tool operators, metal and plastic, in May 2004 were:

Metalworking machinery manufacturing	$16.34
Other fabricated metal product manufacturing	15.62
Machine shops; turned product; and screw, nut, and bolt manufacturing	14.73
Motor vehicle parts manufacturing	13.55
Plastics product manufacturing	11.78

Median hourly earnings of numerical tool and process control programmers were $19.31 in May 2004. The middle 50 percent earned between $15.67 and $24.00. The lowest 10 percent earned less than $12.89, while the top 10 percent earned more than $28.89.

Related Occupations

Occupations most closely related to computer control programmers and operators are other metal and plastic working occupations, which include machinists; tool and die makers; machine setters, operators, and tenders—metal and plastic; and welding, soldering, and brazing workers. Numerical tool and process control programmers apply their knowledge of machining operations, metals, blueprints, and machine programming to write programs that run machine tools. Computer programmers also write detailed programs to meet precise specifications.

Sources of Additional Information

For general information about computer control programmers and operators, contact:

➤ Precision Machine Products Association, 6700 West Snowville Rd., Brecksville, OH 44141-3292. Internet: **http://www.pmpa.org**

For a list of training centers and apprenticeship programs, contact:

➤ National Tooling and Metalworking Association, 9300 Livingston Rd., Fort Washington, MD 20744. Internet: **http://www.ntma.org**

For general occupational information, including a list of training programs, contact:

➤ Precision Metalforming Association Educational Foundation, 6363 Oak Tree Blvd., Independence, OH 44131-2500. Internet: **http://www.pmaef.org**